

# What Else Do Design Professionals Need to Know About Sustainable Buildings Investment? A New Assessment Approach

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## ABSTRACT:

Design professionals typically do not report the true value of sustainable building to their clients in reliable and understandable terms. It is necessary for designers, particularly architects, to understand how investment professionals value their investment choices, what techniques traditionally they use to evaluate their alternatives, and how they account for risk and uncertainty in their investment decision making process. In this paper, first, the deficiency of current building performance tools, such as building simulation programs, sustainability certifications, simple financial methods and building performance-based techniques in evaluation of sustainable buildings are presented. Recommendations are then provided regarding the additional knowledge of financial, risk and uncertainty modeling that designers need if they want to estimate and communicate a more complete assessment of value to the real estate decision makers. The Discounted Cash Flow approach is explained as a financial method, capable of incorporating all costs, benefits and risks for estimating the value. The Monte Carlo simulation is suggested for modeling uncertainties inherent in the evaluation process. Finally, a new assessment process is proposed to align the environmental and social benefits with economic returns of sustainability and to thoroughly evaluate the true value of sustainable buildings, while explicitly including uncertainty.

**CONFERENCE THEME:** on measurement: quantifying sustainability, are we using the correct measures?

**KEYWORDS:** true value of sustainability, sustainable building assessment techniques, financial performance, risk, uncertainty

## I. SUSTAINABLE BUILDING INVESTMENT

Sustainable building investment is not a new concept, it has been around for more than a decade in the United States and longer in Europe. However, with all of the concerns about climate change, global warming, and rising energy costs in recent years, sustainability investment becomes a mainstream consideration in planning and design of most building development, both new construction and retrofit.

Substantial evidence suggests that demand for sustainable buildings has increased over the past several years. Owners, government regulators, investors and designers are the primary drivers in this shift in attitude toward sustainability. Many space users have indicated that they are prepared to pay more for rent or for purchasing sustainable buildings with the expectation to reap the benefits, such as operational cost savings, improved corporate reputation, and health and productivity. Most investors and owners of existing buildings have declared that they would not undertake a retrofit of a building without considering investment in at least some sustainable features. These professionals believe that the benefits of sustainable building investment will increase in coming years; and therefore, they are not only concerned about today's market demand, but also about the possible growing future demand. "The decision for real estate investors and developers today is not whether new projects should be green, but rather how green they should be" (Smith, 2007, p. 1). Even during the recession, owners that fail to adapt quickly to the new standards may find their viability jeopardized" (Nelson, 2009).

### I.1. NEW RESPONSIBILITIES OF DESIGN PROFESSIONALS REGARDING SUSTAINABLE BUILDINGS

There are two groups of decision makers who are involved in the development process of a building: design professionals, who are involved in technical decision making processes, and property



**Figure 1:** Communication between Design and Property Professionals

professionals, who are involved in financial or investment decision making processes. Design professionals include architects, engineers, etc. Property professionals include real estate investors, developers, valuers, lenders, etc.

As illustrated in Figure 1, design professionals would generally propose design alternatives and provide property professionals with information concerning the impacts of their design suggestions (costs and benefits) on building performance. Property professionals process the cost-benefit information with their own decision-making techniques, and make the final decision about whether or not to proceed with investing in those proposed alternatives. Essentially, property professionals make their investment decisions based on their predictions of value, both revenue and risk. Private investors need to ensure that the projects they are investing in will generate a reasonable and competitive rate of return in the market with the lowest possible risk; they need to know if the risks associated with their investment are adequately compensated by expected returns generated—risk and revenue trade off.

It is important to note that the sustainable building investment procedure is not essentially different from that of a typical property investment analysis from risk and return perspectives. In fact, a thorough communication of value, both revenue and risk, is much more critical when analyzing a sustainable building / feature investment opportunity, due to insufficient market data, and limited knowledge and experience with sustainability investment of property professionals. Real estate investors/owners need to fully understand how sustainable building features affect the value of their investments. They must recognize the financial return they might have received above the amount they would received when not investing in these features. Thus, a clear, comprehensive, and reliable presentation of value of sustainable buildings in the way that property professionals could understand and apply in their decision making process is vital. *This will add a new task for design professionals involved in sustainable buildings planning and design to not only thoroughly evaluate the building performance but also communicate the added value to the decision makers.*

It is the responsibility of design professionals to communicate the full scope of costs and benefits of sustainable features to property professionals. Designers should be able to explain how their sustainable design alternatives impact the building performance and how those impacts could affect the property value. This information, if presented in a reliable and understandable language, will enable real estate investors/owners to make more informed decisions about sustainable building investment. Regarding the new assignments and business activities of architects and engineers, Lützkendorf and Lorenz (2005) have also stated that “in the future, clients will ask about the effects of these design and planning solutions on overall building [financial] performance. This creates a new client need that the design team can fulfil by providing building related information relevant to valuation and rating purposes” (p. 231).

Currently, design professionals do not report the true value of sustainable building to their clients, due to their incomplete or unreliable evaluation methods and lack of their knowledge of the investment decision making process. *Communicating the financial performance of sustainable buildings reliably requires performing more sophisticated financial and statistical analyses than what designers traditionally do.*

In order to better communicate to owners and investors, it is necessary for design professionals, particularly architects, to understand how property professionals value their investment choices, what techniques traditionally they use to evaluate their alternatives, and how they account for risk and uncertainty in their investment decision making process. Having knowledge of the investment decision making will enable designers to better organize and align their technical ideas and suggestions

with the owners/investors goals. According to the USGBC (2008), “without consistent and reliable documentation of benefits, it is difficult for many building owners to commit to appropriate high-performance building. Without robust financial tools that address sustainability issues, financial institutions can not readily meet their fiduciary and statutory obligations in funding innovative and transformative technologies” (p. 16).

This paper will introduce appropriate financial, risk, and uncertainty methods that are used by investment communities for analyzing investment decisions.

## 1.2. SUSTAINABLE DEVELOPMENT AND BUILDINGS

It is generally accepted that sustainable development has three categories of benefits including environmental, social and economic. Buildings that have the potential to contribute to sustainable development simultaneously provide all three benefits to a lesser or greater extent. A growing body of evidence suggests that the building industry has become mature enough to recognize that all three areas of benefit, particularly those improving health and productivity, could have positive impacts on property value. Health and productivity are known as central parts of the social benefits of sustainability. Until recently, health and productivity have received less attention among the private investors because there are substantial risks and uncertainties involved in the quantification of their benefits and investors are not able to account for them in their costs-benefits analysis. However, these professionals have now realized that social aspects of sustainable development, such as adaptability, functionality, health and productivity, could significantly influence total real estate costs and users demand, and therefore, should be taken into account in the costs-benefits analysis of sustainable buildings.

Muldavin (2010) has argued that from a financial perspective, sustainable property is what regulators, potential space users, and investors in the subject property defined as a sustainable property. “Proper financial analysis of a property requires explicit consideration of the potential benefits that will accrue through meeting regulator, user, and investor thresholds for sustainability” (p. 17). Thus, simultaneous consideration of all the sustainability benefits that might impact users’ satisfaction is critical in understanding the full scope of costs and benefits, and therefore, the true value of sustainable buildings.

## 1.3. COSTS, BENEFITS, RISKS AND UNCERTAINTIES ASSOCIATED WITH SUSTAINABLE BUILDING INVESTMENT

“The benefits [of sustainable buildings] range from being fairly predictable (energy and water savings) to relatively uncertain (productivity/health benefits). Energy and water savings can be predicted with reasonable precision, measured, and monitored over time. In contrast, productivity and health gains are much less precisely understood and far harder to predict with accuracy” (Kats, 2003, p. v). Unfortunately, the majority of current sustainable building investment decisions are solely made based on tangible cost savings, while full costs and benefits of sustainability are beyond cost savings. For example, improved worker health and productivity in an office building may contribute to significant cost savings for employers because of lower absenteeism and recruiting costs. Achieving sustainability certification, such as LEED, would increase the reputation and marketability of the subject building, which would lead to higher absorption rates and higher value.

Risk is a significantly important component of the costs-benefits analysis. No assessment of a sustainable property value would be completed without a full assessment of risks, both positive and negative. The positive risks may increase the potential benefits and negative risks may increase the potential costs. “Reduced risk is perhaps the most significant benefit of sustainable property investment” (Muldavin, 2010, p. 126). Later in this paper, it is explained that there is also uncertainty inherent in each step of sustainable buildings valuation. A clear and well-supported presentation of risk and uncertainty of achieving the expected value of sustainable buildings is critical in preventing underestimation or overestimation the value of sustainable building. If designers ignore risk and uncertainty of sustainable building investments in their analyses, they might mislead their clients. This would result in destroying their reputation and jeopardizing their consulting business.

Some of the potential benefits associated with sustainable building investments that are often ignored in current analysis procedures include: access to state or federal government incentives; tax and insurance benefits; better financing options; contributing to achieving green certifications; reduce the carbon emission; improve indoor air quality, daylighting and thermal comfort (environmental benefits); increase adaptability, serviceability, and functionality; improve health and productivity (social benefits); increase property reputation and marketability; and increase asset value or revenue due to improved appeal to regulators, space users and investors, which would lead to higher rent, higher occupancy, lower turnover, etc.

Potential risks inherent in sustainable buildings investment include: reduce the risk of losing value due to functional, economic or physical obsolescence; reduce the risk of losing users and investors due to availability of sustainable buildings in future markets; reduce the risk of inaccuracy of projected building performance; reduce energy consumption volatility; reduced liquidity risk; and reduced legislative risk (Bozorgi & James, 2010a).

Consequently, both tangible and intangible benefits could contribute to the financial value of sustainable buildings in the way that investors are interested in. *Without a simultaneous consideration of the full scope of costs, benefits, risk and uncertainty associated with sustainable building investment, understanding their true value of is not possible.*

## **2. CURRENT SUSTAINABLE BUILDINGS ASSESSMENT METHODS**

Tools and techniques that are currently widely used for assessing building performance are categorized in the following four types. The results of these methods are typically accepted as the basis for making technical and investment decisions by both design and property professionals. In this section, it is explained that why none of these tools on their own are sufficient to rely upon for making major high-quality investment decisions at the property level.

### **2.1. GREEN BUILDING CERTIFICATIONS**

Current Green Building Certifications and Energy Rating Systems, such as LEED, BREEM, and EnergyStar are very often used as a basis for comparing the performance of sustainable buildings. However, these certifications cannot be the sole basis for defining sustainability for the purposes of major investment decision-making because of the following issues:

First, they have been designed to measure the environmental impact of sustainability, and therefore, due to their environmental outcomes rather than financial outcomes, are not able to communicate the overall performance of sustainable building to the investment decision-makers. Second, they do not provide any detail about the sustainable features employed in the building and many of the sustainable features that have contributed in achieving the certification may not have a significant direct impact on property performance from a financial perspective. And finally, many buildings might have employed valuable sustainable attributes that could influence their market value but are not certified; therefore, relying upon certification may ignore the impact of those sustainable features on financial performance and may lead to undervaluation. “That suggests that something more granular than Energy-Star or LEED is needed to capture the green design elements that contribute to enhanced environmental, economical, and social performance which in turn link to building value” (Mudavin, 2008, p. 9). However, it is very important to consider these elements in the financial analyses as many studies have shown that they made a positive contribution to the overall market value of a sustainable property because of their impact on reputation and marketability.

### **2.2. BUILDING SIMULATION PROGRAMS**

There are many Building Simulation Programs (BSPs), such as DOE 2, Energy-Plus, Radiance, Computational Fluid Dynamics (CFD), etc. developed to evaluate building performance indicators such as energy consumption, daylighting, and indoor air quality. These programs are typically used to provide supporting data for achieving certification to perform simple cost-based financial analyses.

The primary issues with directly using the results of these programs for making major investment decisions are as follows:

First, these tools are primarily designed to forecast impacts of design decisions on environmental performance indicators and do not take into account other aspects of sustainable building performance /benefits. Second, their outcomes are typically described in technical terms rather than financial. Most of these tools are well developed to evaluate building performance, but fail to properly link indicators to financial performance and do not translate the technical details to a more understandable language. According to Lorch, Lützkendorf, & Lorenz (2007), “the largely technocratic approach is, on its own, not enough to bring about the necessary change. What is needed is to encourage dialogue and learning between the construction community and practitioners from the property, finance, insurance and banking industries” (p. 1). And finally, the simple financial analyses that these tools perform are based on simple estimation of cost savings, payback period and simple return on investment (Bozorgi & James, 2010b).

### 2.3. SIMPLE FINANCIAL METHODS

The financial analysis techniques traditionally used by real estate investors, owners and lenders for assessing the financial performance of sustainable buildings include: Simple Payback (PB), Simple Return On Investment (ROI), Energy-Star financial tools, etc. These approaches primarily focus on initial development cost and operational cost savings, and ignore the full scope of costs and benefits.

The full costs and benefits of sustainability—environmental and social issues along with financial return—are beyond cost savings and traditional sustainability analysis (Muldavin, 2010); and ignoring them, may undervalue the sustainable investments and exclude many profitable investment opportunities from consideration, which ultimately would lead to underinvestment in sustainability. Nevertheless, because of their simplicity, these types of simple analysis are used very often; they might be good enough to address minor investment decisions, such as minor, but are not sufficient for major retrofits or acquisition decisions.

### 2.4. BUILDING PERFORMANCE-BASED METHODS

Building Performance-Based Methods such as Life Cycle Costing (LCC), Life Cycle Assessment (LCA), General Cost-Benefit Analysis (CBA), or Value Engineering (VE), are widely used by decision makers, both technical and financial, to evaluate the performance of a sustainable building over its life. The primary problem with most of these methods such as LCC or VE is the cost-based nature of their financial analysis, which would lead to the ignorance of other non-cost benefits of sustainability investment. LCA-based techniques are recognized as one of the best approaches for evaluating the environmental and some of the social aspects of sustainability. They are well developed to incorporate building performance over its entire life cycle. While LCA “takes the issue of occupant health into consideration, there is less focus on occupant satisfaction, functional fit and productivity” (Lützkendorf & Lorenz, 2005, p. 224). Therefore, to date, performance-based approaches are unable to deal with all aspects of sustainability simultaneously. Furthermore, they are not well suited to account for sustainability investment value, risks, and uncertainties simultaneously in their evaluation process in the way that investors require.

*In summary, current assessment methods and analytics do not simultaneously incorporate all of the costs, benefits, risks and uncertainties of sustainability investment, nor represent them in the way that assists investors to make informed investment decisions. Design professionals need new assessment methodologies to consider all impacts of sustainability on property market value as well as their associated uncertainty and communicate the added-value in appropriate terms to be understood and utilized in the investment decision-making process. This approach requires more sophisticated financial/valuation techniques for estimating the property value and more sophisticated statistical techniques for incorporating uncertainties of a sustainable building valuation.*

### 3. PROPERTY VALUATION

Property valuation is the practice of developing an opinion of the market value or worth of a real property. “The purpose of a valuation is to forecast the future benefits of a property and calculate this into a current price. The accuracy of that valuation will depend on the ability and skill of the valuer in understanding the factors that determine values, and the weight that those factors hold” (Bowman & Wills, 2008, p. 12). Below, three basic approaches that are traditionally used by property professionals to determine market value are presented. All three approaches may not be applicable for all situations or may not result in accurate estimates for market value. Valuers must select the most appropriate approach based on type of property investment (new or existing property) and available data, in order to provide the most accurate indication of market value.

1) Cost Approach: This method estimates the value of a property based on the sum of the cost of the land and depreciated (present value) cost of reproduction and replacement of existing improvements. This approach could be appropriate when costs data is available and market conditions are stable. As Chappell and Corps (2009) stated, given limited national cost estimating database for sustainable buildings, this approach would likely prove less dependable and accurate, particularly for an older, existing property. (p. 14).

2) Sales Comparison Approach: This method estimates the value by comparing the subject property with transaction data (sales data) of similar properties in the surrounding or comparable data. This approach could be most useful when sufficient empirical data of similar properties is available. This approach is not yet appropriate for sustainable building valuation due to current insufficient market data for comparison. Often, sustainable buildings are compared based on their certification level. The challenge with this approach is that sustainability can be achieved through a variety of different features. Even two LEED certified buildings with the same level rating might have employed different systems and design strategies in achieving a certification. They might have different building performance and financial performance, and therefore, should not be considered comparable. Until more time passes and more market evidence are generated, this approach remains inappropriate for sustainable building valuation.

3) Income Capitalization Approach: This approach estimates value based on the present value of the income stream produced by the subject property. This is the primary valuation method for income producing property such as office or multi-family buildings. The methods used under the income approach primarily fall into the three categories: direct capitalization, discounted cash flow, and gross income multiplier. The discounted cash flow model, as the most common technique, is described below:

#### 3.1 TRADITIONAL DISCOUNTED CASH FLOW (DCF) METHOD

One of the powerful valuation methods currently used in real estate investment is the DCF method. This technique evaluates the present value of the projected future cash inflow and outflow over a holding period. The DCF model is able to deal with the complexity of various factors involved in real estate valuation and to incorporate its related expenses, revenues, and risks simultaneously.

As shown in Figure 2, the DCF model takes the explicit assumptions on future rents, occupancy rate,

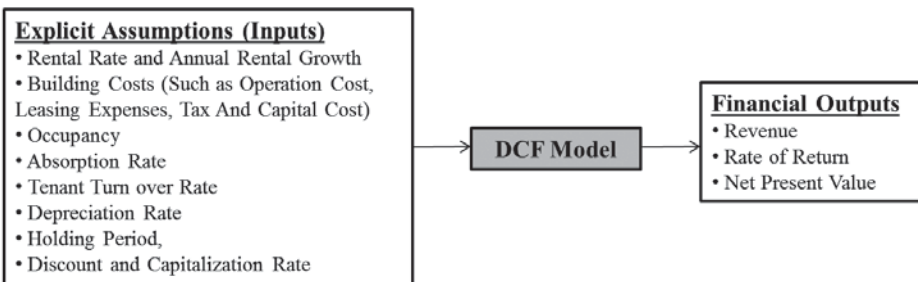


Figure 2: DCF Model Inputs and Outputs

operation costs, etc. as inputs and estimate the financial outputs such as revenue, rate of return, or net present value. These financial outcomes are the metrics that investors use for evaluating investment options. The more accurate DCF inputs would result in the more accurate financial outputs. It is the responsibility of valuers to do as much market research as possible and forecast the DCF assumptions.

For example, one of the most important assumptions in a DCF model is the discount rate that is used to calculate the present value of all future cash flow streams. The discount rate reflects the risk associated with receiving the projected cash flows. The greater discounted rate will be selected for riskier project while the lower discounted rate will be selected for the projects with lower level of investment risk.

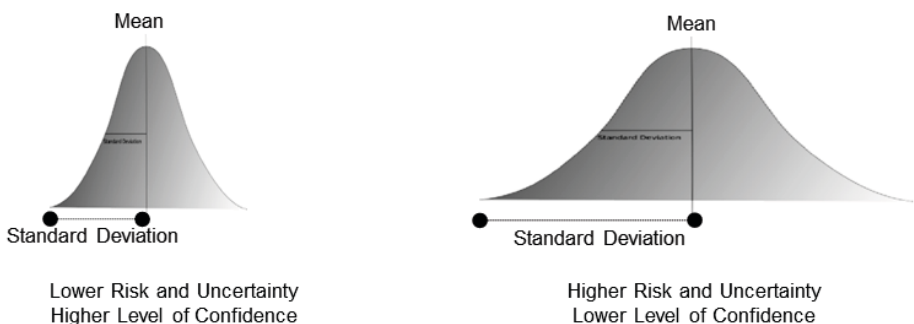
This approach currently is viewed as the most appropriate approach to provide a more reliable indication of market value of sustainable property. *We encourage design professionals to utilize the concept of the DCF approach in lieu of simple PB, simple ROI, or LCC for estimating the financial performance of sustainable buildings.* With the DCF method, potential direct and indirect costs, benefits and risks associated with sustainability investment, stated previously, could be considered in generating the investment's revenue. Consideration of both revenues and risks in the valuation process will allow designers to provide their clients with the true value of sustainable buildings. It should be noted that using the concept of DCF approach requires sufficient market data upon which to rely for determining DCF inputs, such as future rents, occupancy, etc. With the absence of sufficient market evidence for sustainable buildings, there is a substantial uncertainty associated with predicting DCF inputs. However, even with current limited hard data, DCF approach gives the users a proper financial method to acknowledge and consider factors that have impacts on future property value, rather than ignoring them in the assessment process and misleading the final decision makers.

## 4. UNCERTAINTY

### 4.1. DEFINITION OF RISK AND UNCERTAINTY

Risk is known as a situation in which alternative outcomes and their probability of occurrence are known, where as uncertainty is a situation where information about future outcomes and their probability are not known. "Uncertainty is anything that is not known about the outcome of a valuation at the date of the valuation, whereas risk is the measurement of the value not being as estimated" (French & Gabrielli, 2005, p. 81).

Probability distributions are the primary quantitative vehicle used for explaining risk in the risk management analysis methods. The probability distribution describes a range of possible values and the probability of any value within any subset of that range. All variables that are uncertain could be represented with probability distribution, and their associated risks could be estimated using statistical approaches based on specifications of a range of most likely values (means) or extreme values. The variability of the expected return about its mean is used as a description of risk, and



**Figure 3:** General Interpretation of Shapes of Normal Distribution (Bozorgi & James, 2010b, p. 3:25)



standard deviation is commonly used as a measure for spread of probability distribution. As shown in Figure 3, the tighter distribution of outcome with smaller standard deviation represents the lower risk and uncertainty and high level of confidence in achieving the expected outcome (mean). Flat distribution with large standard deviation denotes the great degree of risk and uncertainty and low level of confidence (Bozorgi & James, 2010b, p. 3:25)

## 4.2. UNCERTAINTY IN PROPERTY VALUATION

There is general agreement that there are risks and uncertainties associated with property valuation procedures that need to be identified, assessed, and reported in a way that can be understood and analyzed by investors or end users. For example, the uncertainty of DCF inputs (explicit assumptions about future factors) or the risk of not achieving value or rate of return as predicted in DCF (estimation of DCF outputs). Acknowledgement of uncertainty inherent in the valuation process would provide investors with useful information about the level of confidence in receiving their expected return and therefore insight

*Considering uncertainty involved in sustainable buildings valuation, it is vital that design professionals account for uncertainty when analyzing the value of a sustainable building; otherwise, the outcomes of the valuation process may be underestimated or even overestimated, and may lead to inappropriate investment decisions. In the DCF model, the inputs are included as single point estimates and therefore, the uncertainties of the DCF assumptions are not taken into account. Inability of the traditional DCF model to deal with uncertainty in the valuation process requires a more sophisticated approach to explicitly account for uncertainty.*

## 4.3. MONTE CARLO SIMULATION (MCS)

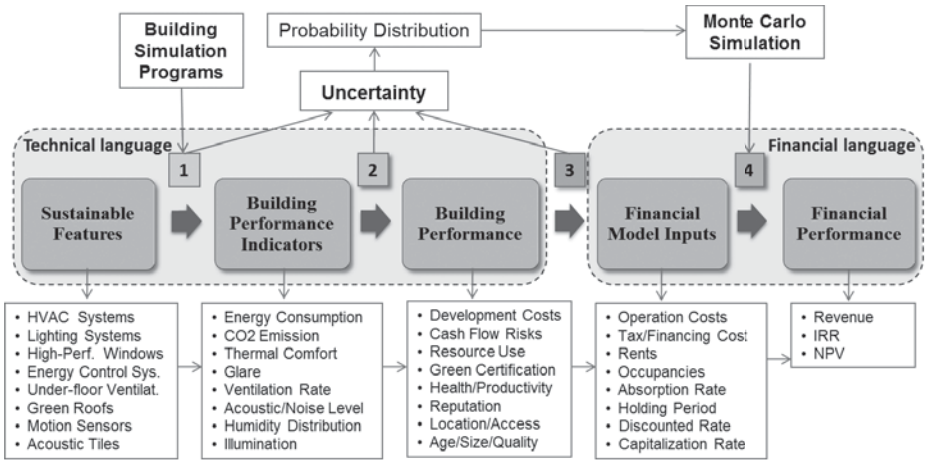
"Monte Carlo analysis is a widely used numerical computational analysis tool that draws information from input probability distributions, applies the data in a process, and generates an outcome distribution" (Jackson, 2008, p. 137). This technique is able to account for uncertainties by allowing for a range for each input and its correlations at the same time, perform a random probabilistic sensitivity analysis and model a range of possible outcomes. In the MCS, simulation data is processed and ranges of final outputs are estimated through the base model which describes the relationship between inputs and outputs. The results allow decision makers to better analyze and interpret uncertainty and provide them with more reliable information than a few discrete scenarios. This method is also suggested to include various uncertainties of valuation by describing the range of possible values instead of a single-point estimate of value in the DCF model.

We encourage design professionals to use the MCS for modelling uncertainty and estimating the final financial performance indicators of sustainable building. The base model for this simulation, which describes the relationship between inputs and outputs, is built based on the DCF approach. This probabilistic model takes and analyzes the same DCF inputs and outputs but replaces single estimate points with appropriate ranges and probability distributions. The MCS incorporates the uncertainties of achieving the DCF inputs and articulates the risks related to receiving these outcomes.

## 5. NEW ASSESSMENT PROCESS

We propose a new assessment approach to estimate the true value of sustainable building. *Unlike the current sustainable building assessment process, this new process explicitly connects performance estimates from the design professionals to the property valuation techniques to communicate to property professionals in a common language. With this new approach, designers could also better understand the impact of their design decisions on financial performance of a sustainable building at the design stage, which would result in more viable designs.* In development of this process emphasis has been placed first, on the simultaneous consideration of environmental, social, and economic benefits in context of value, and second, on the explicit consideration and articulation of valuation uncertainties. The process is illustrated in Figure 4:





**Figure 4:** A Process for the Valuation of Sustainable Buildings

The process begins with taking the sustainable features and estimating their related building performance indicators through the appropriate BPSs. For each selected system, certain building performance indicators can be determined, for example, energy consumption as an indicator of energy performance, or ventilation rate and pollution as indicators for indoor air quality. Then, depending on the system and its performance indicators, the selected systems would be modeled through the appropriate BPS. It might be necessary to model a particular sustainable feature with multiple BPSs as most of the sustainable features have impacts on more than one building performance indicators which directly or indirectly contribute to the value of building. For example, using an energy efficiency HVAC system reduces operational costs but at the same time may improve indoor air quality which may improve health and productivity.

*It is very important that designers realize that any building performance indicator that is of interest to occupants could play a role in the financial performance of a building; therefore, a thorough evaluation of all performance indicators that might be influenced by a sustainable feature is required.*

Second is to determine the building performance in terms of both sustainable and non-sustainable factors. Factors related to sustainable features include development costs, occupant satisfaction, and health and productivity, contribution sustainable certifications, achievable incentives, marketability, risks, etc. Non-sustainable building performance, which are not related to sustainable features but critical in valuation of a property, include location, access, age, size, etc. When evaluating a sustainable building, some sustainable factors such as costs, possibility of achieving certification or incentives, can be estimated relatively easily based on available data, guidelines, regulations and BPSs outcomes. However, factors such as users' satisfaction, and health and productivity are more difficult to measure precisely.

Third is to select key financial model inputs based on building performance estimates, which includes all costs, benefits and risks associated with the sustainable building investment. This is the translation step from technical to financial language. The traditional DCF approach is suggested as a base model for estimating the true value of sustainable buildings. Valuers consider all sustainable and non-sustainable factors, determined in the previous steps, simultaneously, assess the market responses (regulators, space users and investors' demand) and forecast the DCF model inputs.

Last is to calculate the value based on the DCF model inputs. Monte Carlo simulation with a base case built upon the DCF approach is suggested to estimate the final financial performance indicators while modeling uncertainties.

## 5.1. CONSIDERING UNCERTAINTIES INHERENT IN SUSTAINABLE BUILDINGS VALUATION

As stated previously, there is a certain amount of uncertainty associated with measuring the outcomes of each step in the valuation process. Some of these uncertainties include:

uncertainty associated with forecasting building performance indicators by building simulation programs; uncertainty associated with achieving any certification or energy label; uncertainty inherent in determining the building performance, such as health and productivity based on projected outcomes; uncertainty associated with future energy price escalation, interest rates, or inflation; uncertainty associated with forecasting the financial model inputs, such as future rents.

These types of uncertainty need to be considered in order to communicate reliable outputs to final decision-makers. *Specifying a probability distribution for each uncertain variable, involved in the process, is suggested in order to incorporate and articulate their uncertainty.*

It should be noted that this paper is not intended to provide information about estimating and collecting data required for each step for the proposed process. A thorough discussion about incorporating the various factors in the process will be presented in future publications by the authors.

## CONCLUSION

Design professionals are not able to estimate and communicate reliable financial performance data for sustainable buildings if they solely rely on their current approaches and knowledge. They need to utilize more sophisticated financial/valuation and statistical techniques in order to present the true value of sustainable buildings to property professionals. While designers are not expected to perform a thorough market analysis and predict accurate financial model inputs, they are expected to provide comprehensive, reliable and understandable information to their clients and assist them in making investment decisions. They are expected to acknowledge that benefits of sustainable building investment are beyond cost savings and to consider full costs, benefits, risks and uncertainties in their analysis. The suggested methods, DCF and MCS, are examples of such techniques that would enable designer to do the above.

Therefore, the authors believe educating the design professionals, particularly architects, about property valuation and the investment decision-making process, and providing them with a defined procedure to follow to understand the impact of their design decisions on those factors that are important for the property professionals, could be helpful toward communicating the true value of sustainable buildings and driving their market.

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